WASHINGTON
SCIENCE TRENDS

HIGHLIGHTS

* AIRCRAFT CORROSION PROBLEMS
* FLEXIBLE ANTENNAS
* DEFENSE COMMUNICATIONS
* RANGER DATA HANDLING
* RESEARCH CHECKLIST
* PUBLICATION CHECKLIST

Volume VI, No. 7 May 1, 1961

AIRCRAFT CORROSION PROBLEMS

The Navy has discovered serious corrosion problems in A-3D carrier squadrons and other types of late-model aircraft, apparently due to the affects of salt water and "stack gases" on aluminum structures. The problem, described as intergranular corrosion, has brought about an intensive inspection, correction and research program in recent months.

✓ A New Problem -- Navy officials have advised Congress that this particular type of corrosion was not recognized as a serious problem in aircraft until late in 1960, since it apparently does not affect earlier aircraft than the A-3D.

Officials attribute this to the fact that finer alloys and lighter metals are being used in newer aircraft. In addition, later model aircraft use large sections of rather solid aluminum milled down to size in contrast to earlier practice, in which thin aluminum structures have been built up to size.

✓ Where Corrosion is Found -- Officials state that corrosion is being found on skin surfaces, on control actuating rods and cranks and other sections. They exhibited to a Congressional subcommittee a doubler plate which is put on top of the joint of the wing to the fuselage. It is believed that a combination of salt water and sulfur from the stack gases penetrated between a rivet head and the plate itself. Officials explained: "It begins to penetrate back into cracks in the material so it does not show up on the surface, and the only surface evidence we can find is a little crack in the paint (which) creates a battery action."

✓ Action Being Taken -- The Navy declares that it has its own engineers and specialists from the aluminum industry working on this problem. With the present type of surface treatment intergranular corrosion apparently occurs within 12 to 15 months. Since the safe span is not yet certain all affected aircraft must be carefully inspected. When possible, affected parts are ground down to set limits for repair purposes.

In addition, attempts are being made to:

Develop a device to fluoroscope or x-ray aircraft components, so that corrosion damage can be located.

Develop a treatment or coating which can prevent intergranular corrosion in the future.

✓ ANTENNA PROTECTION ALSO REQUIRED -- The Navy has previously stated that salt water and stack gases, combined with sunlight, also causes difficulty with ship antennas by coating them with acid. Unless the antennas are adequately protected the antennas disintegrate rapidly. Present protective coatings crack easily, it was stated, and do not protect antennas for a sufficiently long time.

* FLEXIBLE ANTENNAS

The Air Force is testing antennas that can be packed into containers the size of a box camera, and then expanded on command to full size arrays. The antennas can be erected by mechanical or pressure techniques after a carrier vehicle obtains orbit. They are said to be potentially useful for satellite-to-satellite communications, and weather mapping.

The Air Force reports:

✓ Mechanical erection is best for rigidity and fidelity of shape, but is limited to sizes under four feet in diameter because of weight limitations, and the fact that volume expansion is limited to about a 10-1 ratio.

✓ Pressure erection techniques have important potentials because of light weight and volume expansions as high as 100-1. An antenna folded into a one cubic foot box, it is reported, can be unfurled into a sphere six feet in diameter, and remain useful as long as 12 months.

✓ A variety of structures, ranging from complicated frames of straight elements to large curved surfaces can be achieved through pressure techniques, permitting construction of antennas for a large number of specific applications.

✓ Strong, flexible materials are required because the structure must maintain its own rigidity once established. Materials must be able to withstand environmental effects such as micrometeorite bombardment, absence of air pressure, solar and nuclear radiation, and extreme temperature variations. Pressure-erected models are made of a "sandwich" of sealed laminates of plastic and aluminum foil. They are less rigid than mechanically erected structures, and have less resistance to micrometeorite bombardment. Mechanical models are made of steel and are erected by spring action.

✓ Largest pressure model is the sphere, which uses metallic coatings of appropriate portions of the surface for antenna purposes. Other pressure models include a zig-zag periodic structures antenna which is eight feet high when unfurled, and can be folded into a six inch cube -- and a linear array of helices four feet long which can be rolled up into a four-inch cylinder.

(Experimental models designed by Lockheed Missile and Space Division, Sunnyvale, Calif. and Schjeldahl Co., Northfield, Minnesota for Antenna Section, Reconnaissance Laboratory, Aeronautical Systems Division, Air Force Systems Command, Dayton, Ohio)

* DEFENSE COMMUNICATIONS AGENCY PLANS

The Kennedy Administration is now placing added emphasis on the communication and control aspects of national security. A key role in this program is being played by the Defense Communications Agency, which is designed to provide the Department of Defense with efficient and effective, long-haul, worldwide communications.

Among projects under consideration:

✓ Reconfiguration of the three military department common user teletype, voice and data networks.

✓ Consolidation of various communication facilities.

✓ Studies of ways to make maximum use of existing service facilities, including ways and means of making them interoperable, so that there can be transfers of traffic when one system is overloaded and another is not.

✓ Research studies on communication technology, an analysis of Army, Navy and Air Force planned communication programs, and an analysis of current and planned communication satellite programs.

* RANGER DATA HANDLING SYSTEM

The Jet Propulsion Laboratory, operating for the National Aeronautics and Space Administration, estimates that some 95 percent of the information received from previous space experiments has had to be disregarded, chiefly because no provisions were made to put the data in a convenient, useable form.

Plans are underway to correct this situation when the Ranger series of space probes are launched, starting later this year. An IBM 7090 high-speed automatic digital computer will be used as the major information-transforming device. Here is a summary of data handling plans from JPL:

✓ Data Transmission -- The Ranger spacecraft will transmit its data in both analog and digital form. Each mode will require special ground equipment to effect the transformation of data to a form suitable for the computer. For example, Lyman-alpha data will be in analog form and magnetometer data will be in the form of frequency vs. time. All other data will be received in digital form as encoded by the spacecraft's Data Automation System (DAS).

✓ Data Receiving -- All data will be received by the Deep-Space Instrumentation facility, which is comprised of antennas at Goldstone, California; Woomera, Australia; and in the area of Krugersdorp, Union of South Africa. Data will be recorded on magnetic tape at each site, and tapes will then be transported to the JPL telemetry Data Reduction Laboratory where the signals will be demodulated from the carrier frequency, and noise removed. Magnetometer frequency data and the Lyman-alpha analog data will be transformed into digital data, while all digitized data will be transformed by a specially built data translator and recorded on a magnetic tape that can be fed directly into the computer.

✓ Data Correlation -- In order to correlate the data with the position of the vehicle, those parameters which give the initial trajectory conditions will be fed into the system. When used in conjunction with the trajectory computer program, these parameters give the desired positions at any time.

✓ Computer Phase -- The computer accepts this information serially into its memory, first checking the data to determine whether or not they pass certain parity tests and frame-synchronization markers inherent as check points in the transmitted data. Once it is established that the data are correct, calibration factors are applied to each experiment in order that the numbers will be of significance to the reader. Many of the experiments use counters which will accumulate information, rather than reset each time. Therefore, the computer will calculate successive differences between readings, and will calculate averages, ratios and other desired parameters. The computer will also make comparisons with the results of other experiments.

✓ Output -- The output labels each experiment and gives the time the data were received in the spacecraft. All of the transformed data will be printed numerically on a tabulator which prints 120 digits per line and 8 lines per inch. JPL estimates that approximately 6 pages laid side by side will be necessary to represent 1 line for 1 minute. Because it would still be very difficult to examine visually these large amounts of numbers for significance, a pertinent number of the columns of printed data will be converted into a graphical form using an x,y plotter (with time along the base at a rate of 1 hour per inch.)

It is anticipated that several experiments can then be plotted above each other so that it will be much easier to see any correlation and trend with time among the various experiments, relevant geophysical data and terrestrial observations of solar events which will be noted on the same plots. JPL also expects that from these observations, it should be possible to deduce a mathematical model which can be placed into the computer for testing.

RESEARCH CHECKLIST

□ HIGH PURITY TRIMETHYLBORANE: The National Bureau of Standards has succeeded in preparing trimethylborane of 99.9 percent mole purity for use as a neutron capturing gas in proportional counters, and as a subject of thermodynamic investigations. Special precautions, including custom-made stainless steel apparatus, were necessary because the compound is a gaseous, toxic, reactive material that ignites on contact with air.

(For further information on High-Purity Trimethylborane write National Bureau of Standards, Office of Technical Information, Washington 25, D. C.)

□ IMPROVED ARMY SEARCHLIGHT: The Army has developed a new 30-inch general purpose searchlight half the size of current models, but with twice the range and intensity. The unit employs a liquid-cooled carbon arc mechanism in conjunction with a parabolic reflector to produce 450 million peak beam candlepower with a beam width of 3.25°. Continuous operational periods of from 6 to 9 hours are obtained by the use of a disk negative electrode and joined positive electrode rods. Power is furnished by an air-cooled gasoline engine drive, 400 cycle AC generator, with output rectified to DC by the use of silicon diodes. The searchlight is expected to be generally available to the Army by 1963.

(Manufactured by Strong Electric Corp., Toledo, Ohio. Development by U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.)

□ PILOT CONTROL OF VEHICLE RENDEZVOUS IN ORBIT: Detailed simulator studies by the National Aeronautics and Space Administration have shown that human pilots will be able to rendezvous one space vehicle with another orbiting vehicle under severe conditions. A rendezvous vehicle does not have to be in the same plane with a space station to effect a contact. Adverse initial launch conditions do not effect the pilot's ability to control the rendezvous as long as his vehicle has enough total impulse to complete the maneuver. A list of pilot preferences for instrumentation and retro rocket performance were also determined. Pilots do not consider continuously variable rocket thrust necessary. They prefer to use intermittent thrust of constant value. Instrument presentations the pilots consider vital are range and range rate-of-change, elevation and azimuth line-of-sight rate, vehicle attitude angles, vehicle attitude angle rates, elevation and azimuth angles.

(Report available. Write National Aeronautics and Space Administration, Attn: CODE BID, 1520 H Street, N. W., Washington 25, D. C. regarding NASA Technical Note D-747)

□ HIGH SPEED IMAGE SHUTTER UNIT: A high speed image shutter unit has been designed for the Air Force by ITT Laboratories, Ft. Wayne, Indiana, with details now available. An image tube operating as an electronic shutter, consists of a photocathode and a phosphor screen as an anode, separated by an electrostatic lens. An optical image focused on the photocathode produces an electron image which is focused on the phosphor screen by the electrostatic lens. If a high-voltage pulse of short duration is applied to the diode, the event will be transferred to the phosphor screen -- and the persistance of the phosphor permits time for the image to be photographed. With this equipment up to 12 pictures of a self-illuminating event such as an exploding wire or arc may be taken sequentially at extremely fast exposures with no intervening time between pictures.

(Report of April, 1960 now available, as WADD Technical Report 60-216 ((Pb 171 197)) through military channels or at $1.75 from OTS, U. S. Department of Commerce, Washington 25, D. C.)

□ NEW ARMY GENERATOR SET: The Army has developed a new 15-KW diesel precise power electric generator set for use in antiaircraft radar systems and other applications where portability is of prime importance. The set weighs 2,286 pounds including dry batteries. Both 60 and 400-cycle generators can be built to the same overall dimensions so that space provided for trailer mounting of one can readily accommodate the other to provide either kind of electric power. In addition, many of the engine accessories are interchangeable among a "family" of generators under development.

(R&D by U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.)

□ RAPID PREPARATION OF MASTER TERRAIN MODELS: Photomechanical means for the rapid production of 3-dimensional terrain models has been developed by the Aeronautical Chart and Information Center of the USAF using a photopolymerization process patented by Haloid Xerox, Inc. The 3-dimensional models are made by passing light through a built-up 2-dimensional transparency which has a separate negative layer for each elevation desired on the model. The light passing through this transparency is graded into continuous tones representing height differences and it is then projected into a fairly deep photosensitive solution which polymerizes and hardens depending upon the amount of light striking it. After an exposure of a minute or so the unhardened portion of this photosensitive gel can be washed away leaving a 3-dimensional model. After a brief period of additional hardening procedures the model can be used to make vinyl rubber molds for casting, reproduction, etc.

The demand for 3-dimensional terrain models has been great in recent years to provide simulated effects for radar training, briefings and the orientation of some types of guidance systems. Most of this work has been done laboriously by hand and great efforts have been made to find an adequate "automatic" means of model preparation. This process described in an Air Force report, now available, has shown considerable promise, but more advances in this area are expected in the near future.

(USAF Aeronautical Chart and Information Center Interim Technical Report No. 91 available through military channels or at 50 cents from OTS, U. S. Department of Commerce, Washington, D. C.)

□ RECORDING VISCOELASTOMETER: A device for determining the viscosity and elasticity of liquid polymers has been developed by the National Bureau of Standards. It has already been used to measure the linear viscoelastic behavior of such polymers as polyisobutylene and polystyrene, and can be used to determine the viscoelastic properties of asphalt, roofing tar, and with modification, vulcanized rubber.

(For further information on viscoelastometer for measurement of flow and elastic recovery write National Bureau of Standards, Office of Technical Information, Washington 25, D. C.)

□ CERAMIC COATINGS FOR ALUMINUM: Army studies, now available, indicate unfavorable results from the use of fused ceramic coatings on rocket launcher components which are to be subjected to direct rocket blasts. Tests showed that the brittleness of ceramic coatings somewhat offsets advantages gained by their high heat resistance. Also, costs may be prohibitive. Army investigators concluded that further tests should be made on resilient coatings for rocket applications, with such coatings containing or composed of elastomers.

(Rock Island Arsenal Technical Report 60-3203 ((PB 171 047)) available through military channels or at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C.)

PUBLICATION CHECKLIST

- ☐ HIGH STRENGTH STEEL FORGINGS, a report mainly concerned with forgings made from martensitic steels heat treated to strengths ranging from 240,000 to 300,000 psi. Summarizes much new information in this field. 62 Pages. Free to Government agencies, contractors, subcontractors and their suppliers. (Write Defense Metals Information Center, Battelle Memorial Institute, Columbus 1, Ohio regarding DMIC Report No. 143)

- ☐ DESIGN CRITERIA FOR PORTABLE SEISMOGRAPHS, a summary of information necessary for the construction and use of three-point-supported portable seismographs commonly used to measure surface vibrations of ground, rock and structures resulting from blasting or other sources. 6 Pages. Single Copies Free. (Write Publications-Distribution Section, U. S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa. for Report of Investigations No. 5708)

- ☐ IONOSPHERE BEACON SATELLITE, a report in detail of experiments designed by various laboratories for the Ionosphere Beacon Satellite S-45, including information to enable scientists throughout the world to participate in the program. 28 Pages. Single Copies Free. (Write National Aeronautics and Space Administration, ATTN: Code BID, 1520 H Street, N. W., Washington 25, D. C. for NASA Technical Note D-695)

- ☐ ELECTRICAL FUSES, a technical report by The Sandia Corp. on fuse performance, construction, circuit considerations, applications and testing. 23 Pages. (Available as SCTM 304-60(14) through AEC Channels or at 75 Cents from OTS, U. S. Department of Commerce, Washington 25, D. C.)

- ☐ CHRONOLOGY OF MISSILE AND ASTRONAUTICS EVENTS, a fine day-by-day history of the Space Age, including a number of useful charts showing launchings and results of rockets and space vehicles dating back to the German V-2. Also provides a convenient check list of Congressional Reports and Published Hearings. 189 Pages. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D. C. regarding House Report No. 67)

- ☐ PROPOSALS FOR NEW BUILDING RESEARCH, a compilation of research proposals presented at the 1959 and 1960 meetings of the Building Research Institute. 72 Pages. $4. (Write Building Research Institute, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C. regarding Pub. No. 831)

- ☐ VISION RESEARCH REPORTS, a collection of reports presented before the Armed Forces-National Research Committee on Vision at its 1957, 1958 and 1960 meetings. Includes some early material in satellite visibility and in visual acuity under conditions of motions of either target or observer and an unclassified report concerning the dazzle effects of nuclear explosions. 186 Pages. $2.50. (Write Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C. for Publication No. 835)

- ☐ NEW FRONTIERSMEN, a pamphlet listing names and titles of more than 300 officials in the White House and various agencies appointed or retained in office by the Kennedy Administration. 24 Pages. 15 Cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for "Principal Officials in the Executive Branch Appointed January 20-March 20, 1961")

- ☐ RADIOISOTOPES IN THE TEXTILE INDUSTRY, a study by the Textile Research Institute on problems areas in textile technology where radioisotope techniques might be applied. 26 Pages. (Available as NYO 2640 through AEC channels or at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C.)